

DOCUMENT RESUME

ED 474 723

SE 067 687

AUTHOR Woodrow, Derek
TITLE Learning Preferences of PGCE Students: Implications for Recruitment of Mathematics Teachers.
PUB DATE 2001-00-00
NOTE 26p.; In: Key Stage 3 Mathematics Teachers: The Current Situation, Initiatives and Visions. Proceedings of a National Day Conference. Open University, 2001. p22-46. For full document, see SE 067 440.
PUB TYPE Reports - Research (143)
EDRS PRICE EDRS Price MF01 Plus Postage. PC Not Available from EDRS
DESCRIPTORS Foreign Countries; Higher Education; Learning Strategies; *Mathematics Education; Professional Development; *Teacher Recruitment; Teacher Selection; *Teacher Supply and Demand
IDENTIFIERS *United Kingdom

ABSTRACT

Applications for entry to Higher Education have persistently shown marked differences between ethnic minority groups and marked gender preferences, particularly for mathematics and the sciences. One reason for these differential choices is suggested by research into learning preferences. This is examined in this paper, which reports on a large-scale study of the preferred styles of teaching and learning of undergraduates and Postgraduate Certificate in Education (PGCE) students. Clear subject differences in these learning preferences were identified with mathematics students consistently at one end of the scales and English students at the other. Some implications of these findings for the recruitment of mathematics teacher training students are discussed. (Author)

Learning Preferences of PGCE Students: Implications for Recruitment of Mathematics Teachers

Derek Woodrow

Manchester Metropolitan University - Institute of Education; UK

Abstract

Applications for entry to Higher Education have persistently shown marked differences between ethnic minority groups and marked gender preferences, particularly for mathematics and the sciences. One reason for these differential choices is suggested by research into learning preferences. This is examined in this paper, which reports on a large-scale study of the preferred styles of teaching and learning of undergraduates and PGCE students. Clear subject differences in these learning preferences were identified with mathematics students consistently at one end of the scales and English students at the other. Some implications of these findings for the recruitment of mathematics teacher training students are discussed. The author would like to acknowledge that the research reported in this paper was carried out by Janis Jarvis at Manchester Metropolitan University.

Introduction

Table 1: Ethnic origin of accepted applicants, by subject group, 2000 entry (Percentages, cf.1996 entry)

	ASIAN		BLACK		WHITE		TOTALS	
	Men	Women	Men	Women	Men	Women	Men	Women
Medicine/Dent.	5 (6)	5 (6)	1 (1)	1 (1)	1 (2)	2 (2)	2 (2)	2 (2)
Sub. allied med.	5 (6)	10 (9)	6 (3)	10 (6)	5 (2)	9 (7)	5 (3)	9 (7)
Biol.sciences	2 (4)	6 (7)	2 (3)	4 (5)	4 (5)	7 (7)	3 (5)	7 (7)
Maths/informatics	33 (21)	12 (9)	22 (18)	8 (7)	13 (11)	3 (3)	16 (13)	4 (3)
Eng'ing and Tech.	10 (14)	2 (2)	12 (17)	2 (2)	10 (13)	1 (2)	10 (13)	2 (2)
Social studies	9 (11)	16 (18)	10 (13)	19 (22)	10 (11)	13 (14)	9 (11)	14 (15)
Languages	1 (1)	3 (3)	1 (1)	3 (3)	4 (4)	8 (10)	3 (4)	7 (9)
Humanities	1 (1)	1 (2)	1 (1)	1 (1)	4 (4)	4 (5)	3 (4)	3 (4)
Education	0 (1)	3 (3)	1 (4)	3 (6)	2 (7)	7 (11)	2 (6)	7 (10)
Combined sciences	4	3	3	2	2	2	3	2
Soc.st. with arts	1	3	2	5	2	4	2	4
Total Numbers	15552	14567	4312	5728	110828	129298	145177	163541

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION
CENTER (ERIC)

- ☐ This document has been reproduced as received from the person or organization originating it.
- ☐ Minor changes have been made to improve reproduction quality.

- Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

PERMISSION TO REPRODUCE AND
DISSEMINATE THIS MATERIAL IN MICROFICHE,
AND IN ELECTRONIC MEDIA FOR ERIC
COLLECTION SUBSCRIBERS ONLY,
HAS BEEN GRANTED BY

b. Fraser

TO THE EDUCATIONAL RESOURCES
INFORMATION CENTER (ERIC)

When UCAS first collected data in 1990 on the ethnic origins of applicants to Higher Education it posed a variety of questions about how students made their choice of subject (Taylor, 1993; Modood, 1993; Woodrow, 1996). It is clear that students from different ethnic groups have shown differential subject choices. The data in Table 1 (from UCAS Table G4) has been presented in terms of the percentage of acceptances from a particular group choosing a particular subject to study. Differences between the ethnic minority students and between genders are clear and persistent. Three times as many women study languages as men, six times as many men study engineering. Over 22% of Asian students (33% of Asian men) and 14% of Black students apply for Mathematics and Informatics compared to 7.5% of White students. This confirms a common perception that Asian students, in particular, are drawn to the subject, but so also are Black students. There are also interesting variations within ethnic groups (i.e. different Asian and Black groups) which have interesting features. Note however that the increase in recruitment to this group of subjects is very much to IT, mathematics recruitment remaining fairly constant:-

MATHEMATICS/INFORMATICS RECRUITMENT

2000		1999		1998		1997		1996		1995		1994	
M	W	M	W	M	W	M	W	M	W	M	W	M	W
25195	6430	23119	5895	20214	5000	18089	4414	16327	3922	15244	3595	14664	3524
31625		29014		25214		22503		20249		18839		18188	

MATHEMATICS RECRUITMENT

2000			1999			1998	
Men	Women	Total	Men	Women	Total	Total	
2485	1567	4052	2402	1454	3856	3925	

It is tempting to begin to draw speculative reasons to explain these differences, and some of these were explored in a previous article (Woodrow, 1996). The evidences for any particular explanation of these differential recruitment figures are not strong but the cultural milieu from which the students derive will have some effects. There has also been a long and significant debate about gender bias in respect of

mathematics and science yet there seems little real movement. Woodrow (1996) suggested that learning styles have a significant influence. Indeed, for one group relating significantly to mathematics (the Chinese) Sham and Woodrow (2000, 2001) have shown that they strongly retain a very distinctive learning style to that of their White compatriots. For other groups there is little clear evidence in the U.K. relating to their learning styles, however, in a major exploration of learning styles in the USA Dunn (1990) contrasted African-Americans, Chinese-Americans, Mexican-Americans and Greek-Americans. She found significant differences, and in particular that African/Caribbean students had totally reverse preferences to Chinese students in 15 out of 21 learning preferences, such as working co-operatively or alone, working in the morning or evening, working in noise or quietness.

Learning Preferences : Chinese Americans/African Americans
(after Dunn et al., 1990)



On subject choice and learning styles Woodrow conjectured that the way in which Mathematics is taught and learned might well select people with particular personal characteristics - authoritative, focused and convergent personalities - which might not be the most suitable for activities such as teaching (where interpersonal skills and adaptability are paramount). A small-scale survey of 38 students at the University of Lancaster reported in a DFE (1994) paper, relating to shortages of maths and science students, also conjectured that:

Science and technology students liked the lack of essays, the highly structured courses, practical work, having an answer, being accurate and doing a vocational subject. They didn't like the fact that arts 'is all about learning' and studying in the arts was 'very isolated'

Non-science based students disliked scientific subjects because they required extremely hard work, heavy reliance on experiments and practicals, emphasis on accuracy (too fiddly), full and inflexible timetables, few opportunities for self-development.

However what the subject-related learning styles really are and how they relate to subject variations in recruitment is still somewhat unclear. The current research project, described below, is designed to begin to explore these issues.

Learning styles

Individual differences in learning styles have been the focus of much attention from time to time, but there remains widespread confusion about the terminology used.

However, the constructs themselves can be basically grouped into two main types of learning style. These are often distinguished as *cognitive style* and *learning preferences* and the underlying differences between these are essentially based on the degree of stability of the style within the learner and the bi-polar nature of cognitive style definitions. The most critical difference between different researchers lies in their commitment to 'stability' and in general one expects a cognitive style to be stable over time, whereas a learning preference might be expected to vary somewhat with context. Thus in the context of this enquiry ownership of a particular cognitive style might well lead a student to choose a particular subject to study, whereas a learning preference might well be imposed on a student by his/her choice of subject of study. In practice (like the nature/nurture debate) this is likely to remain an ambiguous dialectic. (For a more extensive debate on this see Jarvis and Woodrow on www.leeds.ac.uk/education-line.)

Approaches to learning

Currently, the most prominent area of research on this area of learning styles is based on the 'approaches to learning' model originating from Marton and Saljo's (1976) studies of 'deep' and 'surface' approaches. A deep approach consists of studying for its own sake, for personal interest and is meanings-related. A surface approach is

essentially the opposite. It consists of studying to fulfil extrinsic demands and relying on memorising, whilst making little attempt to relate material to previous knowledge. Skemp (1977) identified a corresponding relationship to 'understanding' in his discussion of relational understanding (built upon a search for relationships and meaning) and instrumental understanding (a more functional learning of techniques and facts).

Choosing the instrument for enquiry

The focus of this study is on both learning preferences as conceptualised by the approach to learning model (using the Biggs' (1987) model of questionnaire) and cognitive aspects of learning represented by a student's regulation of learning processes and beliefs about knowledge. The interrelationship of these cognitive aspects with strategic leaning preferences is thus explored. In order to do this a new instrument was devised, incorporating approaches to learning questions with others directed towards epistemological beliefs and regulation of learning. Little is known about how students adapt their learning styles in a real educational context. The nature of different academic disciplines lend themselves to particular learning styles and the study reported here is also concerned with the subject specificity of certain learning preferences.

Disciplinary differences in learning

There has been some research into the categorisation of different academic subjects; one of the most widely used taxonomies is one devised by Biglan in 1973. He distinguishes between 'hard' and 'soft' subjects based on the paradigmatic basis inherent within each subject. Those subjects that have a single paradigm, or hard subjects, would be more fixed in content as areas of interest and research methodologies are usually agreed. Subjects without a paradigmatic basis, or soft subjects, have idiosyncratic contents and method with no consensual area of study or research. Under this classification, maths and science are hard subjects and humanities and social sciences soft. Subjects like business studies which appear

towards the middle of the continuum are said to be 'striving for a paradigm' (Biglan, 1973).

These subject differences appear in the way they are taught and learned. There is widespread belief that maths, foreign languages and sciences are characterised by more teacher-led methods than arts, humanities and social sciences. The DES reported in 1972 that Mathematics and Modern Foreign Languages were the most problematic subjects in the moves then being made towards mixed ability teaching. The criteria for success in the hard subjects are often more straightforward with an emphasis on right and wrong answers. One can easily see a link between cultural philosophies which emphasise respect for authority and the attraction towards subjects that allow students to more easily reinforce expert knowledge.

It is well reported that teachers' strategies for managing their classrooms are inevitably subject-specific but there is little research concerning the learning preferences of students within different subject areas. It seems likely that those studying soft subjects will incline towards the more interactive techniques while an acceptance of the teacher as authority is more likely to occur in the hard subjects. Similarly, stereotypes suggest talent or natural ability are necessary for success in maths, languages, music and art, whereas effort and effective study strategies are more likely to signify success in social science or humanities. These notions affect students' perceptions of their ability and self-esteem. A student performing badly in a maths test is less likely to attribute a poor result to lack of effort and success or failure is seen as beyond personal control. This fatalistic attitude will be reflected in the undervaluing of self-regulating study techniques which are then seen as having little effect on achievement outcomes.

The study looks at the interrelationship of four aspects of learning: *approaches to learning, interaction, beliefs about knowledge and regulation of study strategies*. It is only possible to speculate on whether any preferences are developed as a result of the

subject matter or whether personal predisposition has led the individual to move towards subjects which reflect his/her preferences.

To measure these different dimensions of learning preferences an instrument for self-completion was developed which made it possible to express each of the four aspects in a summated score. The questionnaire as a whole contained items relating to biographical details as well as a section of items referring to preferred methods of learning which were to be ranked in order. The largest section of the questionnaire, though, was a 50 item 4-point Likert scale. The items were subjected to item analysis and factor analysis which resulted in the identification/confirmation of the four dimensions mentioned above.

The sample

The sample consisted on a total of 867 students, 483 were working towards their Postgraduate Certificate in Education and were studying in a broad range of subject areas, English, Art, Geography, Music, Social Science, Maths, Business Studies, Design and Technology, Physical Education, Religious Education, and Modern Foreign Languages. The other 384 students were undergraduates, mostly in their first year of study in five specific areas, English, Art, Business Studies, Science and Maths. Of the PGCE students 155 were male and 328 female. The undergraduates consisted of 199 male and 185 female students.

Questionnaires were distributed to students studying for their PGCE at the Manchester Metropolitan University and to undergraduates studying at several different universities country-wide including Keele, Bristol, Nottingham and Manchester. Response rates varied and in most cases the co-operation of a tutor was required to obtain results in sufficient numbers.

Results

The mean scores for students have been calculated within each subject area and for the four dimensions of learning preferences as well as the learning preference scale overall. The lower the score on a scale from 1 to 5, the greater the inclination

towards a deep approach to learning, a relativist view of knowledge, a preference for interactive techniques and self-regulation of study.

Dimension 1: Approach to learning

The overall results for the PGCE students show a clear division between the soft subjects, English, Art and Humanities with lower scores, and the hard subjects of Maths, Science and Languages with the higher scores. The exceptions are PE and RE students with higher scores, but the sample for these subjects was small. The position of Business Studies and PE students has been determined to some extent by their tendency to be more extrinsically motivated than the other students, while Maths, MFL and DT students showed a particular tendency to prefer exact instructions from their tutors.

Table 2: Mean scores by subject - Approach to Learning

<i>PGCE students</i>				<i>Undergraduate students</i>			
Subject	N	Mean	Std Dev	Subject	N	Mean	Std Dev
English	88	2.9593	.5131	Bus.Studies	75	3.3369	.3929
Art	52	2.9952	.6510	English	75	3.3493	.5724
Music	11	3.1136	.6415	Science	89	3.3573	.5266
Social Science	14	3.2798	.4788	Art	47	3.4547	.2943
Geography	32	3.2891	.5927	Mathematics	98	3.4611	.4436
DT	49	3.3282	.5957	Mean	384	3.3902	.4691
Science	94	3.3484	.5409				
Mathematics	49	3.3622	.5617				
Business Studies	33	3.3813	.6916				
MFL	36	3.4468	.6384				
PE	9	3.5185	.3904				
RE	16	3.6094	.5062				
Mean	(483)	3.2490	.6010				

The undergraduate scores show a smaller spread in scores although they are generally higher than PGCE scores. However, whilst the two sets of scores cannot be indicative of developmental tendencies because the study is not longitudinal, the

results would suggest that Maths, Science and Business Studies PGCE students do not use a significantly deeper approach to learning than their undergraduate counterparts. English and Art PGCE students however are much more inclined towards a deep approach than the undergraduates. This would suggest that the ways these subjects are constructed might have an influence on the approach used. The one surprising comparison was that postgraduates were more extrinsically motivated (by exam success) than the undergraduates (perhaps because the ITT context is now so target driven). If postgraduate students had responded as the undergraduate students on this issue then their scores on this dimension the difference in scores between the two groups would have been even greater.

Dimension 2: Beliefs about knowledge

The relative scores in the different subject areas are very similar to the *approach to learning* scale.

Table 3: Mean scores – Beliefs about Knowledge

<i>PGCE students</i>				<i>Undergraduate students</i>			
Subject	N	Mean	Std Dev	Subject	N	Mean	Std Dev
RE	16	1.9375	.4106	Bus.Studies	75	2.2971	.5133
Art	52	1.9973	.5212	English	75	2.3981	.3405
Social Science	14	2.0306	.4986	Science	89	2.5169	.5560
English	88	2.0373	.4723	Art	47	2.5973	.4061
Music	11	2.0779	.4922	Mathematics	98	2.6509	.5482
PE	9	2.1429	.6349	Mean	384	2.4948	.5408
Geography	32	2.2232	.4881				
Business Studies	33	2.2771	.5669				
Science	94	2.2857	.5907				
DT	49	2.3499	.5298				
MFL	36	2.3889	.6801				
Mathematics	49	2.5510	.4957				
Mean	483	2.2195	.5607				

The soft subjects, English, Art and Social Sciences have the lower scores and the hard subjects, Maths and MFL, have the highest scores. This indicates that students of hard subjects are more inclined towards a belief in the transferability of a body of knowledge and are more concerned in acquiring detailed information than general ideas. Undergraduates had higher scores than their PGCE counterparts but again the difference in scores between the Maths PGCE and undergraduates is minimal and the biggest differential is between English PGCE and undergraduates.

Dimension 3: Interaction and Participation

Table 4: Mean scores - Interaction and Participation

<i>PGCE students</i>				<i>Undergraduate students</i>			
Subject	N	Mean	Std Dev	Subject	N	Mean	Std Dev
English	88	2.1006	.5547	English	75	2.5758	.5502
Business Studies	33	2.1602	.6186	Art	47	2.5850	.3334
PE	9	2.1746	.4859	Bus. Studies	75	2.5951	.2813
Art	52	2.1813	.4694	Mathematics	98	2.7744	.4835
Science	94	2.2128	.4983	Science	89	2.8843	.5492
MFL	36	2.2540	.5194	Mean	384	2.6936	.4782
Geography	32	2.2656	.6395				
Social Science	14	2.2908	.3856				
DT	49	2.3440	.6135				
Music	11	2.4156	.5400				
Mathematics	49	2.4738	.6418				
RE	16	2.5804	.5648				
Mean	483	2.2501	.5624				

PGCE students and undergraduate students studying soft subjects are much more likely to interact and participate in the classroom than those studying hard subjects. The non-consensual basis of soft subjects means that there is likely to be a greater degree of uncertainty and debate within the content whereas students of maths and science have a firm paradigmatic basis which is much less open to criticism and

argument. Students of hard subjects may be reluctant to question their instructors, but in other aspects of participation, for example, giving presentations, maths and science students were more likely to enjoy taking part than social science students. This leads to the speculation that enjoyment of discussion and sharing opinions is more related to the context than the personal predisposition of the student.

The relative positions of undergraduate results echo those of the PGCE students although generally PGCE students interact more.

Dimension 4: Regulation of study strategies

Students of hard subjects relied much more on external regulation than students of soft subjects. They showed a reluctance to look beyond their tutors and lecturers for explanations and information. English and Art students on the other hand, were more likely to take control of their own learning by reading round their subject and discussing lectures with their friends.

Table 5: Mean scores – Regulation of study strategies

<i>PGCE students</i>				<i>Undergraduate students</i>			
Subject	N	Mean	Std Dev	Subject	N	Mean	Std Dev
English	88	2.1676	.5453	English	75	2.4417	.5629
PE	9	2.2083	.3590	Bus.Studies	75	2.6117	.3405
Art	52	2.2332	.5920	Art	47	2.6512	.3058
DT	49	2.3367	.5193	Mathematics	98	2.8362	.5565
Science	94	2.3378	.5372	Science	89	2.8427	.5197
RE	16	2.3594	.5606	Mean	384	2.6941	.5096
MFL	36	2.3611	.5854				
Business Studies	33	2.4015	.6795				
Geography	32	2.5000	.6091				
Social Science	14	2.5179	.6276				
Maths	49	2.6862	.6541				
Music	11	2.6932	.4689				
Mean	483	2.3592	.5890				

PGCE students generally had lower scores than the undergraduates indicating that they were more likely to regulate their own studies, however, the differentials again are the least between maths PGCE and undergraduate students.

The overall learning preference scale

Table 6: The mean score for the whole scale

<i>PGCE students</i>				<i>Undergraduate students</i>			
Subject	N	Mean	Std Dev	Subject	N	Mean	Std Dev
English	88	2.3568	.2825	English	75	2.7556	.3608
Social Science	14	2.5167	.2980	Bus.Studies	75	2.8388	.1537
Art	52	2.5481	.3009	Art	47	2.8528	.1174
MFL	36	2.6040	.3362	Science	89	2.8672	.2869
Science	94	2.6305	.2883	Maths	98	3.0190	.2607
Geography	32	2.6368	.3621	Mean	384	2.8768	.2755
Business Studies	33	2.6592	.4148				
Music	11	2.6631	.3164				
RE	16	2.6786	.2736				
PE	9	2.6903	.2317				
DT	49	2.7282	.2762				
Maths	49	2.8242	.3656				
Mean	483	2.6019	.3402				

Maths students overall are shown to use a more surface approach, have a more dualist view of knowledge, interact less and are less inclined to self-regulate their studies than any other students whilst English students appear consistently at the opposite end of the scale.

Overall the learning preference scores of undergraduates are higher than those of their PGCE counterparts but the difference between the scores is greatest for English students and least for Maths students. Generally, students of soft subjects have lower scores than those of hard subjects with Geography and Business studies students in most cases appearing midway between the extremes. Science is usually conceived as

a hard subject but in the results presented here it appears that Science students have learning preferences which are more similar to Humanities students than to Maths students.

General and domain-specific learning preferences

As expected the results from the study show that surface learning, external regulation, belief in transferable knowledge and less interaction in the classroom were more common among students in the hard subjects, particularly maths. The results were consistent in both samples of students. The level of study affected the results in that PGCE students were generally more inclined towards deep learning. The relative positioning of academic subjects on both sets of results reflects the underlying influence of context on students' learning preferences. The choice of the postgraduate students to pursue a teaching career means that they form a unique group and so the apparent developmental nature of learning preferences cannot be assumed from these results, but it may imply that for hard subjects like mathematics a smaller proportion of the cohort (those towards the deep learning end) are available for recruitment to teaching.

Soft subjects attract a greater proportion of female students and the PGCE sample in particular consisted of 68% female students. However when comparisons were made between male and female students across the whole sample, the scores were very similar with the exception of a small difference in the regulation of study score which indicated that females are slightly less likely to be externally regulated. This lack of 'gender' related learning preferences was somewhat of a surprise, and it suggests that whereas learning preferences may well be one significant factor in groups of students choosing their academic career subjects, there are clearly other factors which enter this equation. In particular there still exist strong gender related perceptions of certain subjects which are seen as 'male' subjects and others (including education) which are seen as 'female' subjects. What it did confirm, however, was that the

variations found between subjects were indeed subject related and not a consequence of the differing gender balances between subjects.

The consistency of the results across all four dimensions indicates that there is a relationship between them and that a low score on one dimension is likely to be accompanied by a low score on the other dimensions. Clearly these are also directly related to the subject being studied. However, the underlying dimensions, whilst functionally interdependent, are distinct and the intention is not to speculate on cause and effect relationships.

Preferred methods of learning

Students of different subjects were asked to rank in order the method of learning they felt was best for them. They were given a choice of six different methods that represented interactive, independent and transmission methods of teaching. Ranked in order of preference, the results are as follows.

Table 7: Preferred methods of learning in rank order - PGCE

PGCE subject	Talking and discussing	Doing own research	Reading books	Hearing explanation	Doing Problems	Memorising and practising	Learning from mistakes
English	1	4	2	3	6	7	5
Soc Sci	1	5	7	2	3	4	6
Art	1	5	7	4	3	6	2
MFL	2	7	5	1	4	3	6
Science	1	4	6	3	2	5	7
Geog	1	4	5	2	3	7	6
Bus. Stud	1	6	7	2	3	5	4
Music	1	4	7	2	5	3	6
RE	1	2	3=	3=	5	7	6
PE	1	7	6	3	2	4	5
DT	1	6	7	2	3	5	4
Maths	2	7	6	3	1	5	4

Table 8: Preferred methods of learning in rank order – undergraduates

U/grad. subject	Talking and discussing	Doing own research	Reading books	Hearing explanation	Doing problems	Memorising and practising	Learning from mistakes
English	1	4	5	2	3	6	7
Art	6	4	5	2	1	3	7
BusStud	4	1	6	3	2	5	7
Science	3	7	6	2	1	4	5
Maths	4	7	6	2	1	3	5

Teachers' conceptions of their subjects differ and this affects the amount of freedom that they perceive is available for innovative teaching. English teachers, for example are likely to experience greater autonomy in their choice of content and are able to be flexible in their approach while teachers of maths and languages are more likely to feel they must cover the content of their curriculum in a specific order. Most research on teaching methods concentrates on the introduction of more interactive methods but students themselves have clear ideas about the best way of learning particular subjects.

The most popular method of learning amongst all students, PGCE and undergraduate was talking and discussing with notable exceptions. Maths students felt they learned better by doing problems than talking and so did the Science and Art undergraduates. Undergraduates were much more likely to prefer methods that are more associated with the transmission model of learning, hearing an explanation and doing problems as the following table shows. English students are more likely to feel they can learn independently by reading books and doing their own research than Maths students and along with Arts and Humanities students gave a low ranking to memorising and practising.

Perception of teachers

Student ratings of teaching have been found to differ systematically in relation to academic discipline. Students tend to rate teachers of art and humanities higher than

teacher of maths and science. This is directly associated with a student preference for interactive behaviour regardless of subject being studied and was more evident in the soft subjects (Franklin and Theall, 1992). Although this research found that most students agree on what makes a good teacher, there were also differences between students studying in different subject areas which indicate an appreciation of the constraints and possibilities of teaching within their own subject.

Kember and Gow (1994) identify pastoral interest (talking and listening) and motivation (creating enthusiasm and excitement) as being characteristics of facilitative teaching whilst a good knowledge of the subject and organisation enabling a clear structure of the subject to be taught as characteristic of the transmission model. It would therefore be expected that these teaching orientations would be associated with the learning preferences of students. Students studying in areas where there was a greater inclination towards a deep approach would favour those characteristics associated with learning facilitation (in this study identified as 'easy to talk to', 'listens' and 'is good fun'). Conversely those inclined towards a more surface approach would favour the characteristics associated with the knowledge transmission model (identified in this study as 'knows the subject', 'is organised', 'gives good notes' and 'keeps control of the class'). Students were asked to rank in order what they thought made a teacher they most respected good at his/her job.

It seems that all students most respect a teacher who knows the subject and is organised though they also all want a teacher who is easy to talk to. Maths PGCE students most respected a teacher who was easy to talk to, perhaps reflecting the perceived difficulty of their subject. Maths undergraduates ranked 'gives good notes' the highest. The differences between A-level maths and HE maths have often been reported as representing a shift in beliefs about the nature of maths from algorithmic techniques to argumentation as objectives move from solving problems to constructing proofs. This may be the reason for the change in preferences between

Table 9: Rankings of Teacher characteristics by subject: PGCE

PGCE subject	Knows the subject	Is organised	Easy to talk to	Listens	Keeps control	Gives good notes	Is good fun
English	1	2	3	4	7	5	6
Soc Sci	4	2	1	5	6	3	7
Art	1	3	2	4	5	6	7
MFL	1	3	2	4	6	7	5
Science	1	3	2	4	7	5	6
Geog	1	3	2	6	7	5	4
BusStud	2	3	1	4	6=	5	6=
Music	1	2	3	5	4	6	7
RE	1	2	3	4	7	5	6
PE	2	1	4	6	7	5	3
DT	1	2	3	5	6	4	7
Maths	2	3	1	4	6	5	7

Table 10: Rankings of Teacher characteristics by subject: undergraduates

Und'grnd subject	Knows the subject	Is organised	Easy to talk to	Listens	Keeps control	Gives good notes	Is good fun
English	1	2	3	5	7	4	6
Art	1	4	2	3	7	5	6
BusStud	1	4	2	5	6	3	7
Science	1	5	2	4	7	3	6
Maths	2	4	3	5	7	1	6

undergraduates, early in their studies, and PGCE students having completed their H.E. studies. Undergraduates did not want a teacher who was fun but PE and Geography PGCE students thought it was important. Overall PGCE students ranked 'being organised' over 'gives good notes' with the exception of Social Science students. Science, Maths and Business Studies undergraduates all ranked 'gives good notes' over 'is organised'.

Preferred learning environment

There are many learning environments at Universities, some of which require more interaction than others. Lectures usually are directed at large audiences and require little student participation so it would be expected that students familiar with non-interactive environment would prefer these to seminars and workshops. Students of subjects that are thought to be difficult to learn alone, like maths, would not be likely to prefer individual research. The research explored this theory by again asking students to rank their preferences in order.

Table 11: Preferred learning environment in rank order by subject: PGCE students

PGCE subject	Lectures	Seminars	Workshops	Individual Research
English	3	1	2	4
Soc Science	4	1	3	2
Art	4	2	1	3
MFL	2	1	3	4
Science	1	4	2	3
Geog	3	1	2	4
Bus Studies	3	1=	1=	4
Music	3	2	1	4
RE	1	3	4	2
PE	3	1=	1=	4
DT	2	3	1	4
Maths	1	3	2	4

Table 12: Preferred learning environment in rank order by subject: Undergraduate Students

Undergraduate subject	Lectures	Seminar	Workshop	Individual research
English	3	1	2	4
Art	4	2	1	3
Bus Stud	3	4	1	2
Science	1	3=	2	3=
Maths	1	3	2	4

The results show that while students of the soft subjects prefer seminars, mathematicians and scientists prefer lectures. Those students of subjects with a more practical basis prefer workshops, though these generally proved more popular with undergraduates than PGCE students.

PGCE students

There are very few substantial studies which consider why students choose to take a PGCE course, though there are number of small interview studies of specifically mathematics students, some of which will be reported elsewhere in this conference. (See also Jones et.al., 2000 on students choosing a mathematics degree) There seem to be none at all which look at different reasons students from different disciplines may have for deciding to enter teacher training. A better understanding of the reasons students have, and particularly those in shortage subjects, may help to direct recruitment strategies.

Recent research by Reid and Caudwell (1999) used questionnaire techniques to investigate PGCE students' reasons for choosing teaching as a career. Assessing responses to 21 different possible reasons ranked in importance on a Likert scale, found that the two most popular reasons chosen by 96% of the 453 students were that they enjoyed working with children and that they felt teaching would bring high job satisfaction. They distinguished between Arts and Maths/Science graduates but found little difference in the results, the greatest being that 40% of Arts students compared to only 17% Maths/Science students chose continuing their interest in their studies as important.

The results from the research reported here shows a different perspective in that the reasons for choosing a PGCE course were not restricted by pre-coded responses and so did not ask for opinions on a range of answers. By leaving the question open-ended, students were more likely to respond with their main reason, or the answer that was foremost in their decision. For analytical purposes the responses were grouped into six categories and these represent 93% of all responses. The remaining

7% gave reasons which did not fit into any of the categories and tended to be of a more personal nature. A small minority of students had no intention to teach, using the PGCE course as a stepping stone to another career such as educational psychologist.

The six categories were

- Want a challenging/stable/rewarding career
- Enjoy the subject/want to pass on love of the subject
- Love of children/want to work with children/want to inspire young people
- Always wanted to teach
- Enjoy teaching
- Change in career

The sample consisted of 492 PGCE students studying in 12 different subject areas. This sample contained the 483 students mentioned previously plus 9 extra RE students who completed a questionnaire at a later date.

The most popular response for all students was career-related with 45% of all students stating that they wanted a challenging, stable or rewarding career. However, when analysed by subject there are notable differences. 56% of RE students and 54% of Art students gave this reason but only 22% of PE students. This was also the reason given by 47% of Maths students and 38% of English students. The second most popular reason, in contrast to Reid and Caudwell's (1999) study, was a wish to continue with the subject. Again the highest proportion by subject was RE at 28%, followed by PE at 22%, but no Music students gave this as a reason. 16% of Maths students wanted to stay with their subject and 18% of English students.

Only 12% of the total sample mentioned a desire to work with children. This is very different to the response from Reid and Caudwell's (1999) study where 96% felt that working with children was an important factor. This highlights the differences in results which are obtained by using different methods. Wanting to work with children, whilst undoubtedly a factor in more than 12% of students' decisions to become a teacher, did not seem to be their prime motivation. Only 7% of English

students, the lowest percentage, for example, specifically mentioned children in their response and only 10% of Maths students but at the other end of the scale 22% of Geography and PE students mentioned either a love of children or wanting to work with children.

10% of the sample replied that they had always wanted to teach. This was the only response where there was a large discrepancy between the genders with 4.5% of males expressing this view and 15% of females. This is likely to distort the subject figures where 23% of English students gave this reason. There is a high proportion of female students in the English sample. The reason for the gender differences is likely to be due to women considering careers which will ultimately fit in with family life and some female students did mention specifically wanting a career that would fit in with having children. However only 5% of Modern Foreign Language students, 86% of whom are female, replied that they had always wanted to teach and only 6% of Maths students. None of the Business Studies students or PE students gave this response.

Some students had previous experience of teaching and so were able to respond that they had enjoyed teaching and wanted to formalise their qualifications. This response was given predominantly by Music students (36%) and PE students (33%) but these are subjects where there are more opportunities to teach without a PGCE.

4% of all students stated that their reason for choosing a PGCE course was that they were changing their career. There were big differences here in the subject areas with 16% of Maths students giving this reason. The other subject areas which were well represented in this category are Business Studies, DT and Science. Only a very low number of student in other subjects gave this reason.

The six reasons given above for choosing to take a PGCE course can be broadly divided into vocational and career-related, with a love of the subject, always wanting to teach and wanting to work with children being the more vocational responses. If divided in this way, then 38% of students had vocational reasons for choosing a

PGCE course. Perhaps of more relevance though to the subject specificity of these choices is that a familiar pattern emerges with more English and Humanities students being motivated for vocational reasons than Maths students.

Table 11 Percentage of PGCE students giving vocational reasons for their choice

Subject	Percentage
Geography	50%
English	48%
RE	48%
Social Science	45%
PE	44%
DT	38%
MFL	38%
Science	38%
Art	32%
Music	27%
Business Studies	27%
Maths	22%

There is a gender bias to the responses, however, with 45% of female students and 33% of male students choosing the more vocational reasons. This does not fully explain the differences in numbers though particularly as Geography and Maths are represented by almost equal numbers of male and female students.

The shortage subjects of Maths, Science, DT and MFL are worth considering separately. These subjects are most attractive to people wishing to change their careers and the influence of financial incentives must be a major factor. They tend not to be the subjects selected by students with more vocational reasons for taking a PGCE course and have often been characterised by the recruitment of mature students. This would suggest that financial incentives and an emphasis on career structure and employment security are likely to be more motivating for students in these subjects than more altruistically directed marketing.

More general comments

There are a number of reasons for students choosing or not choosing particular subjects, and similarly, for students choosing a teaching career or not. This study has looked at one potentially major factor on their decision making. What emerges – as it does from the recruitment statistics over the past thirty years – is the continuity and stability of the situation. In the period 1975-1985 when I collected statistics on maths teacher recruitment, there was a fairly stable output of about 1100 students – about 250 of whom were undergraduate B.Ed. students. This was against a target of about 2500 (based on a teaching force of about 25000 and an average working life of 9.35 years; see Woodrow, 1982). Examination of the many documents over the years shows that there has always been a shortfall and one has to ask why this has been less evident in the schools than might have been expected.

The 1986 DES document identified three levels of shortage:-

Overt shortage: measured by unfilled vacancies.

Hidden shortage: where tuition is given by teachers who might be considered as under-qualified

Suppressed shortage: where a subject is under-represented in the timetable.

Having B.Ed. trained teachers concentrate on teaching KS3 rather than wanting to teach A-level was often useful, and many of these courses did encompass two-subject provision. Indeed, many PGCE courses were two-subject courses. This also provided valuable teachers of varying inclinations and skills: though the nature of the mathematics curriculum itself constrains the teaching act. The use of teachers of other subjects in teaching Key Stage 3 mathematics has always been a feature of staffing deployment – the Royal Society report of 1988 discussed how this might be more profitably managed and lead to an opening out of the mathematics diet in schools. The imposition of the current standards and inspection criteria on ITT has meant that such teachers are no longer prepared for two-subject teaching. Clearly there is an argument about the standard of mathematical knowledge required by teachers of mathematics, but there are potential organisational arrangements which

could support a more mixed teacher cohort. The use of 'master' teachers to oversee a curriculum delivered by 'associate' teachers, in turn supported by technician assistance was hidden within the Royal Society 1988 report as potential solution. In the context of a 'nationally prescribed KS3 strategy it might be very attractive. It would again perhaps allow a wider range of skills to be recruited.

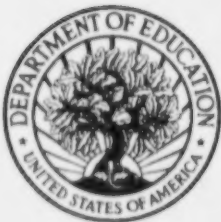
The issue of suppressed shortage is also now a realistic proposition. At the ICME conference last year in Tokyo the worries of the Japanese teachers that their time allowances were being reduced was echoed by delegates from a number of other countries. The increased possibility of the suspension of the National Curriculum in KS4 to enhance vocationally-based provision could well lead to mathematics being replaced, at least in part, by courses in basic/key skills with a different curriculum, an issue touched on by Diana Coben. Mathematics would effectively then become an option subject in KS4; releasing teaching time, or at least relieving some of the pressures.

Clearly we are unlikely to increase significantly the number of mathematicians we recruit to teaching. There are two responses to this, to recruit from other graduate markets (amending our expectations of expertise requirements) or to reorganise the way in which the mathematics teaching force is managed - or both.

References

- Biggs J (1987) *Student Approaches to Learning and Studying*. (Melbourne. Australian Council for Educational Research)
- Biglan A (1973) The Characteristics of subject matter in different academic areas. *Journal of Applied Psychology*, Vol. 57, No 3, pp 195-203
- DES (1986) Action on teacher supply in Mathematics, Physics and Technology (London; DES)
- DFE (1994) 'Science and Mathematics, A Consultation Paper on the Supply and Demand on Newly Qualified Young People', (London, H.M.S.O.)
- Dunn R. et al.(1990) 'Cross cultural differences in learning styles of elementary age pupils from four ethnic backgrounds' *Journal of Multicultural Counseling and development* 18 pp 68-93
- Dunn R (1991) *How learning style changes over time*. Presentation at the 14th Annual Leadership Institute 'Teaching students through their individual learning styles' (New York July 7-13.)
- Dunn R, Dunn K, and Price GE. (1989) *The Learning Style Inventory*. (Lawrence KS. Price Systems)

- Franklin J, Theall M, (1992) *Disciplinary differences. Instructional goals and activities, measures of student performance and student ratings of instruction*. Paper presented at American Educational Research Association. San Francisco. April 1992. Cited in Murray HG and Renaud RD (1995) 'Disciplinary differences in classroom teaching behaviours' *New Directions for teaching and learning*. No. 64 Winter 1995 (Jossey Bass)
- Jones S., Sanders S.E., & Tanner H. (2000) Choosing a Mathematics Degree. A report for the Teacher Training Agency.
- Kember D, and Gow L. (1994) Orientations to teaching and their effect on the quality of Learning *Journal of Higher Education*. Vol. 65, No 1, pp 58-75
- Modood T. (1993) 'The number of ethnic minority students in higher education, some grounds for optimism' *Oxford Review of Education*. 19(2) pp 167-82
- Marton F, and Saljo R (1976) On Qualitative Differences in Learning. 1. Outcome and Process. *British Journal of Educational Psychology* 46, pp 4-11
- Reid I and Caudwell J (1999) Why did secondary PGCE students choose teaching as a career? *Research in Education* 58 47-58
- Royal Society (1972) *The Training of Teachers of Science and Mathematics*. (London; Royal Society)
- Royal Society and the Institute of Mathematics and its Applications. (1988) *How to provide for the teaching of mathematics in secondary schools*. (London; Royal Society)
- Schommer M, Crouse A and Rhodes N (1992) Epistemological beliefs and mathematical text comprehension Believing it's simple doesn't make it so. *Journal of Educational Psychology* 84 (4) pp 435-444
- Taylor P. (1993) Minority Ethnic Groups and Gender in Access to Higher Education. *New Community* 19(3) pp 425-40
- Skemp R.R. (1977) Relational Understanding and Instrumental Understanding *Mathematics Teaching* 77
- UCAS, (2000) *Statistical Bulletin - subject trends*, www.UCAS.ac.uk
- Vermunt JD (1996) Metacognitive, cognitive and affective aspects of learning styles and Strategies. A phenomenographic analysis. *Higher Education*. 31 pp 25-40
- Witkin H (1962) *Psychological Differentiation. Studies of Development* (NY; Wiley)
- Witkin H and Goodenough DR (1977) Field Dependence and Interpersonal Behaviour *Psychological Bulletin* 84 pp 661-689
- Woodrow D. (1982) 'The supply of mathematics teachers' in *Journal of Education for Teaching* 8 (1) pp. 26-33
- Woodrow, D. (1996) 'Cultural inclinations towards studying mathematics and science'. *New Community* 22(1) pp 23-38
- Woodrow D. and Sham.S (2000) Chinese Pupils and their Learning preferences. *Proceedings of the Fifth Annual Conference of ELSIN* (Hatfield, U.K. June 2000) also available on www.leeds.ac.uk/education-line).
- Woodrow D. and Sham.S (2001) Chinese Pupils and Their Learning Styles. *Race, Ethnicity and Education* 4(4) (in press)



*U.S. Department of Education
Office of Educational Research and Improvement (OERI)
National Library of Education (NLE)
Educational Resources Information Center (ERIC)*



NOTICE

Reproduction Basis

X

This document is covered by a signed "Reproduction Release (Blanket)" form (on file within the ERIC system), encompassing all or classes of documents from its source organization and, therefore, does not require a "Specific Document" Release form.



This document is Federally-funded, or carries its own permission to reproduce, or is otherwise in the public domain and, therefore, may be reproduced by ERIC without a signed Reproduction Release form (either "Specific Document" or "Blanket").